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WIND ENERGY SCIENCE DISCUSSIONS
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Interactive comment

Interactive comment on "Aeroelastic Stability of Idling Wind Turbines" *by* Kai Wang et al.

M. H. Hansen (Referee)

mhha@dtu.dk

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Please find further comments in manuscript (attached as figure) and the short notes attached as supplement.

Please also note the supplement to this comment:
http://www.wind-energ-sci-discuss.net/wes-2016-53/wes-2016-53-RC1-supplement.zip

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Discussion paper

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Aeroelastic Stability of Idling Wind Turbines

Kai Wang[1], Vasilis A. Riziotis[2], Spyros G. Voutsinas[2]

[1] China-EU Institute for Clean and Renewable Energy, Huazhong University of Science and Technology, 1037 Luoyu Rd, Wuhan, China
[2] School of Mechanical Engineering, National Technical University of Athens, GR15780 Athens, Greece

Correspondence to: Vasilis A. Riziotis (vasilis@fluid.mech.ntua.gr)

Abstract. Wind turbine rotors in idling operation mode can experience high angles of attack, within the post stall region that are capable of triggering stall-induced vibrations. In the present paper, rotor stability in slow idling operation is assessed on the basis of non-linear time domain and linear eigenvalue analyses. Analysis is performed for a 10 MW conceptual wind turbine designed by DTU. First, the flow conditions that are likely to favour stall induced instabilities are identified through non-linear time domain aeroelastic simulations. Next, for the above specified conditions, eigenvalue stability simulations are performed aiming at identifying the low damped modes of the turbine. The eigenvalue stability results are evaluated through computations of the work of the aerodynamic forces under imposed harmonic motion following the shape and frequency of the various modes. Eigenvalue analysis indicates that the asymmetric and symmetric out-of-plane modes have the lowest damping. The results of the eigenvalue analysis agree well with those of the non-linear work analysis and the time domain analysis.

1 Introduction

In idling mode, the angles of attack (AOA) experienced by the blades significantly vary over one revolution under the combined effect of inflow turbulence, flow inclination and nacelle tilt and yaw. The variation of the AOAs remains substantial even in small yaw misalignments within the range of +/-15^{o}. It is noted that yaw errors in the above range are considered as normal idling conditions by wind turbine manufactures. Going to moderate yaw angles, the variations of the AOA can be such that the rotor enters stall both at positive and negative AOAs and thereby stall induced vibrations are likely to occur. In the past a lot of research effort has been directed to the analysis of stall induced vibrations (SIV) in normal operation, (Petersen et al, 1998; Hansen, 2003; Riziotis et al, 2004; Hansen, 2007), however very little has been done for parked or idling rotors.

Aeroelastic analysis of parked or idling rotors largely relies on blade element aerodynamic models. BEM models comply with industry's needs for fast aerodynamic tools, capable of performing certification simulations. In the context of blade element models, Politis et al (2009) investigated the stability characteristics of an isolated parked blade at various inflow angles using an eigenvalue approach and considering both steady-state but also unsteady aerodynamics. The paper focused on stall induced instabilities. It was shown that such instabilities can take place at inflow angles that slightly exceed C_{Lmax}

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Fig. 1.

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